

**THE DECLINE OF THE  
COMPUTER HARDWARE  
SECTOR: HOW IRELAND  
ADJUSTED**

by

Frank Barry\* and Chris Van  
Egeraat\*\*

*\*School of Business, Trinity College  
Dublin*

*\*\*National Institute for Regional and  
Spatial Analysis and Department of  
Geography, National University of  
Ireland, Maynooth*

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**ALAN BARRETT  
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MARTIN O'BRIEN**

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## **Abstract**

*By the late 1990s Ireland had become one of the major European centres of computer hardware production, accounting for 5 per cent of global computer exports and about one-third of all personal computers sold in Europe. Ireland at this stage also accounted for around 6 per cent of global exports of electronic components. The sector has experienced a sharp decline since then as production has relocated eastwards to China and to Central and Eastern Europe. About one-third of the jobs in the sector were lost between 2000 and 2004. This paper charts the history of the sector in Ireland and analyses the process of employment adjustment as the sector declined.*

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## **1. Introduction**

International relocation of industrial sectors is a continuous process, driven by industry-specific factors such as those emphasised by the product life-cycle model and country-specific changes in comparative advantage. The present phase of globalisation is also heavily influenced by developments in information and communications technology and by the integration of China, India and the former Soviet bloc into the global marketplace.

While certain groups of workers and owners of specific types of capital are undoubtedly hurt by industrial relocation, the consequences are generally thought to be beneficial at both the global and the national level when factor-market adjustments are complete. The adjustment process can take a substantial length of time in a recessionary environment or in the presence of

*Corresponding authors:* \*Frank Barry, School of Business, Trinity College Dublin, [frank.barry@tcd.ie](mailto:frank.barry@tcd.ie)

\*\* Chris Van Egeraat, National Institute for Regional and Spatial Analysis and Department of Geography, National University of Ireland, Maynooth, [chris.vanegeraat@may.ie](mailto:chris.vanegeraat@may.ie)  
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labour-market rigidities however, and these short-term costs must be set against the long-term benefits.<sup>1</sup>

Ireland has been fortunate that the substantial loss of computer hardware employment over the course of the new millennium has taken place under generally benign macroeconomic conditions which have facilitated the reallocation of labour. The paper seeks to chart the adjustment process that has characterised this period. We find that adjustment costs in the Irish case have been lower than might have been anticipated, both because workers found it relatively easy to acquire new jobs and because the departing companies had relatively limited linkages.

In addition to official statistics, the paper also makes use of newspaper accounts and of data collected through interviews. As part of a larger study, three rounds of semi-structured and structured interviews were conducted with general managers of five branded microcomputer makers located in Ireland (for more detailed information see Van Egeraat and Jacobson, 2004). In 2006 additional interviews were conducted with representatives of a range of bodies including the industrial promotion agencies, employment agencies and labour unions. These unstructured interviews specifically dealt with the redundancy process. This more diffuse and retrospective information helps us address the question of what became of those whose existing jobs disappeared.

We find that adjustment took several forms: (i) As hardware assembly firms pulled out, they were frequently replaced by firms operating in related though higher-wage or higher-technology segments. (ii) The assembly firms that remained shifted their Irish operations from assembly into higher value-added non-manufacturing functions such as sales and technical-support call centres and logistics. (iii) The fact that both short-term and long-term unemployment remained low as the hardware sector contracted suggests that displaced workers were able to move to other jobs relatively easily. Though the sector is of course small relative to the size of the total economy, this suggestion is supported by the qualitative evidence offered here.

The paper is structured as follows. Section 2 begins with an overview of trends in the global and European geographies of the computer and computer components sectors and traces the evolution of Irish exports and employment in these and related services sectors. Section 3 follows with a micro-level account of the history of the computer hardware sector in Ireland. Section 4 discusses the outcome of labour shedding within a number of important hardware firms and traces, to the extent possible, the movement of displaced workers to other firms and other sectors. A final section offers some concluding comments.

<sup>1</sup> There is a vast theoretical literature analysing the public-policy issues that arise here; see e.g. the surveys by Kletzer (2004), Baicker and Rehavi (2004) and Barry and Walsh (2008). The latter also review the literature on the impact of international offshoring on wages and labour-market adjustments in the home country.

## 2. Ireland and the Changing Geography of the Computer Hardware and Related Services Sectors

Barry and Curran (2004) provide data on the evolution of the shares of various countries in world computer hardware exports, charting the decline in importance over the 1990s of the more advanced countries in the case of each of the triad regions (Europe, Asia and the Americas) and the increase in export shares emanating from the periphery. In Europe, Ireland's share expanded while that of France, Germany and the UK declined, while in the Americas the shares of Mexico and Costa Rica rose as those of Canada and the US declined. As Table 1 shows, however, the Irish share declined again over the course of the new millennium, as Central and Eastern Europe and, more significantly, China entered the picture.<sup>2</sup>

While Ireland lost ground in both Computers and Electronic Components over the latter period, however, it gained market share in Digital Integrated Circuits. The products in this trade category are of a higher value-added nature than the products in the Electronic Components category. The trade category SITC 77641 includes integrated circuits for a variety of devices, including consumer electronics and automobiles. In the Irish case, the bulk of these exports are accounted for by microprocessors for computers, so Ireland's share of world exports in digital integrated circuits for computers is understated in the table. These data are suggestive of a refocusing within the hardware sector from lower value-added computer components to higher value-added segments.

**Table 1: Country Shares in World Computer Hardware Exports**

	SITC 752			SITC 75997			SITC 77641		
	Computers			Electronic Components			Digital Integrated Circuits		
	1992	2000	2005	1992	2000	2005	1992	2000	2005
Ireland	2	5	4.6	5	6	2.5	0.4	2.4	2.7
United Kingdom	9	8	3.5	7	4	3.7	7.0	3.6	2.8
Hungary	0	1	1.1	0	1	0.34	0	0.03	0.12
Czech Republic	0	1	1.5	0	0	0.49	n.d	0.04	0.23
China	0	6	28.3	1	4	15.4	0.0	0.6	6.9
World (values \$millions)	269,899			183,779			176,882		

*Source:* UN Trade Statistics by SITC (standard international trade classification) category.

Switching from trade to employment data and focusing now solely on Europe, Table 2 depicts the relative importance of computer hardware employment in selected EU25 countries. The table shows that the office machinery and computer and electronic components sectors are relatively important sectors in Ireland. The share of office machinery and computers in manufacturing in 2000 was more than eleven times greater in Ireland than in the EU25. The share of electronic components was also much larger than in the EU25 though less dramatically so than in the case of office machinery as electronic components production tends to be more globalised.

<sup>2</sup> The UK and China are included as benchmarks, while the inclusion of the Czech Republic and Hungary is designed to illustrate the inroads being made by the CEEC.

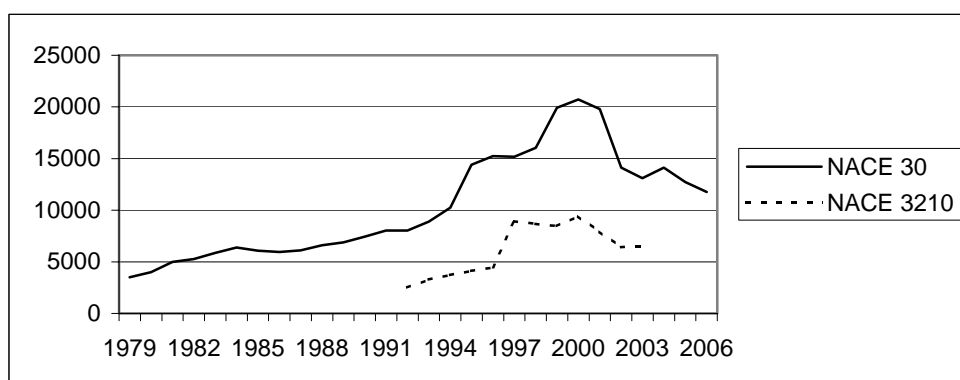
**Table 2: Computer Sector Employment as a Share of Total Manufacturing in Various EU25 Countries**

	Office Machinery and Computers			Electronic Components	
	Nace 30			Nace 321	
	2000	2003	2004	2000	2003
Ireland	8.0	5.7	6.4	3.7	2.9
UK	1.4	1.0	0.9	1.1	0.8
Czech Republic	0.3	0.6	0.7	1.4	1.3
Hungary	1.5	1.5	1.0	2.8	1.9
EU25	0.7	0.6	n.d.	1.0	0.9

Source: Eurostat.

The share of both sectors has been falling significantly in recent years however, as have absolute employment numbers. Raw employment numbers are plotted in Figure 1, and recent trends in Ireland, the US, the EU15 and the CEEC10 in Figures 2 and 3.<sup>3</sup>

**Figure 1: Irish Employment in Computers and Components, 1979-2006**

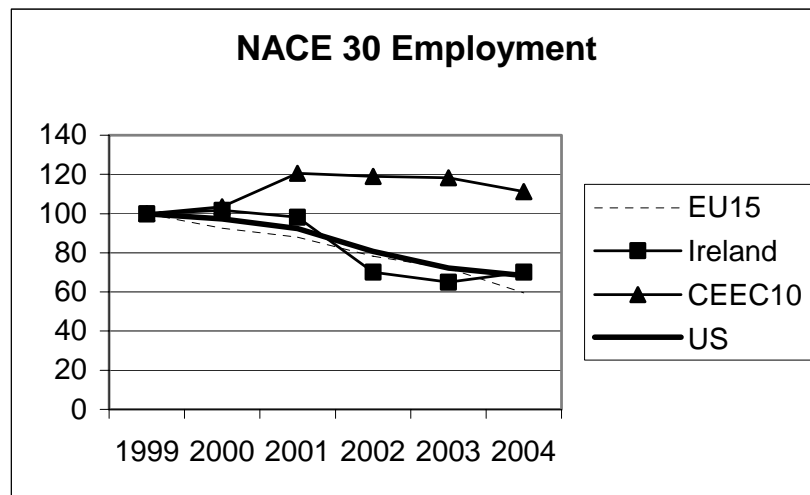


Source: Eurostat; Central Statistics Office *Census of Industrial Production*.

The fall in Ireland's global export share suggests that the decline in Ireland's computer hardware sector is ascribable to shifting comparative advantage rather than to a global high-tech downturn in the wake of the dot-com bubble.

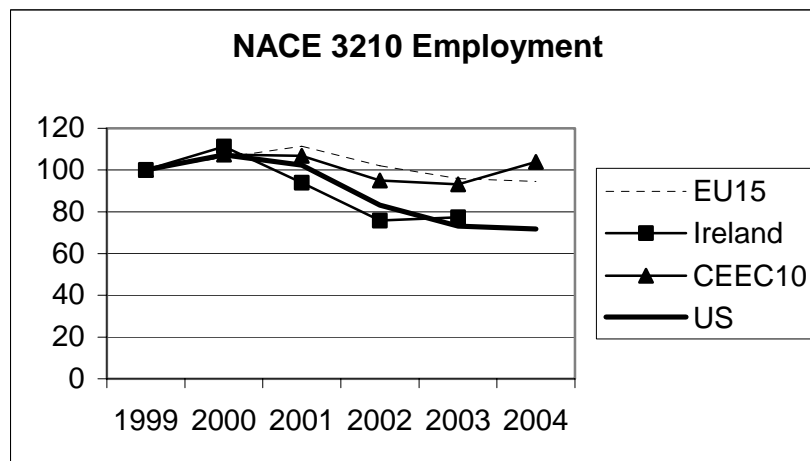
<sup>3</sup> The CSO employment figures for the two NACE categories include employment in services activities carried out in enterprises where the majority of output is classified as manufacturing. Our knowledge of the main companies involved suggests that on balance the figures overstate the number of computer hardware jobs in Ireland. A small shift of employment can lead to a company being reclassified from manufacturing to services (if the change is sustained for two years) in which case the loss of hardware jobs will be overstated. On balance, we believe that this leads to a modest overstatement of the fall in hardware employment. As will be illustrated in the case studies of the main companies in the sector, however, the reduction in computer hardware employment is genuine and significant.

**Figure 2: Employment Trends in Computers, 1999-2004**



Source: Eurostat and US BLS.

**Figure 3: Employment Trends in Electronic Components**



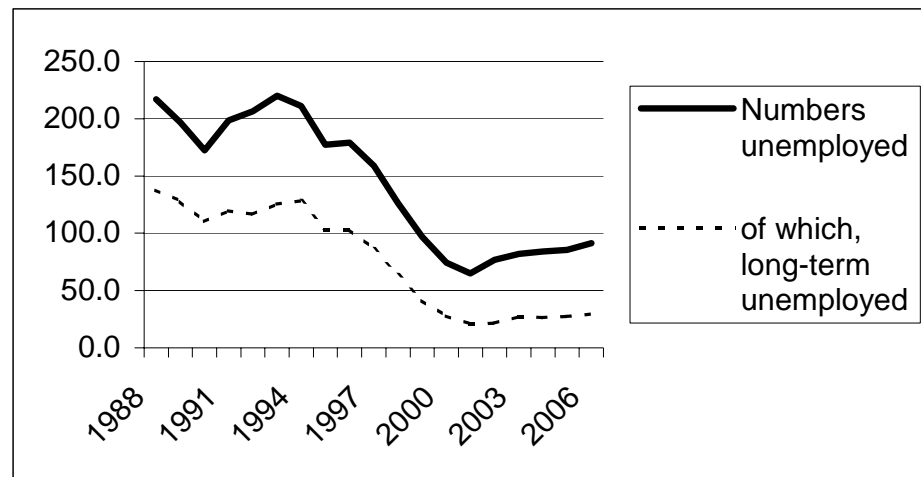
Source: Eurostat and US BLS.

Note: The CSO reports that the local unit data for NACE 3210 are confidential for the years 2002-2005 while the enterprise level data are also confidential for 2004 and 2005.

Over this period, however, the Irish labour market remained buoyant, with unemployment declining from a total of 159,000 in 1997, representing a rate of 10 per cent, to around 91,000, yielding a rate of around 4 per cent, in 2006. The rate of long-term unemployment (of over 1 year's duration) declined even more precipitously, from 5.6 per cent (86,000) to 1.4 per cent (30,000), as seen in Figure 4.

Hence, it is unlikely that displaced workers would have encountered anything like the difficulties they might have encountered in other European countries in trying to find alternative employment. It is our contention – for which the case study analyses offer supportive evidence – that many of these displaced workers would have found employment in the expanding services sector, and in particular in computer-related service activities.

**Figure 4: Unemployment and Long-Term Unemployment in Ireland**



Source: *Quarterly National Household Survey* (April), Central Statistics Office.

Ireland's strong showing in attracting FDI projects in these services areas is illustrated by data from UNCTAD (2004, p. 162) which show that Ireland – with about 1 per cent of the EU15 population – captured 17 per cent of new call-centre FDI projects and 7 per cent of new IT-services FDI projects in the 2002-03 period.<sup>4</sup> Data on computer and information services *exports* are unfortunately not available for all countries (notably India) and are hence frequently combined with exports of “other business services”. As Van Welsum and Rief (2006, Figures 1 and 2) show, not only did Ireland achieve outstanding growth in this combined category between 1995 and 2003, it was also starting – unlike many of the other high-growth countries – from a relatively high base.

Turning to the employment data, Table 3 presents data from the Annual Services Inquiry, showing that for the five-year period 1999 to 2004 employment in computer services and related services activities grew by nearly 10,000, an increase of 53 per cent. Total services employment grew by 43 per cent, creating 220,000 new jobs.

The Forfás *Annual Employment Survey* represents another data source, this time on internationally-traded services. From this we calculate employment in business process services export (BPSE) activities other than in international financial services. Around half of the indigenous BPSE segment and one-third of the foreign-owned BPSE segment is thought to be in software and computer services and the remainder comprises a variety of other services including call centres, shared services, supply chain management, sales and marketing, intellectual property licensing, professional consulting and internet-based business.

<sup>4</sup> It is well-known, furthermore, that while Ireland's share of global merchandise trade has declined in recent years, its share of global services trade has undergone a rapid expansion; Forfás (2005).

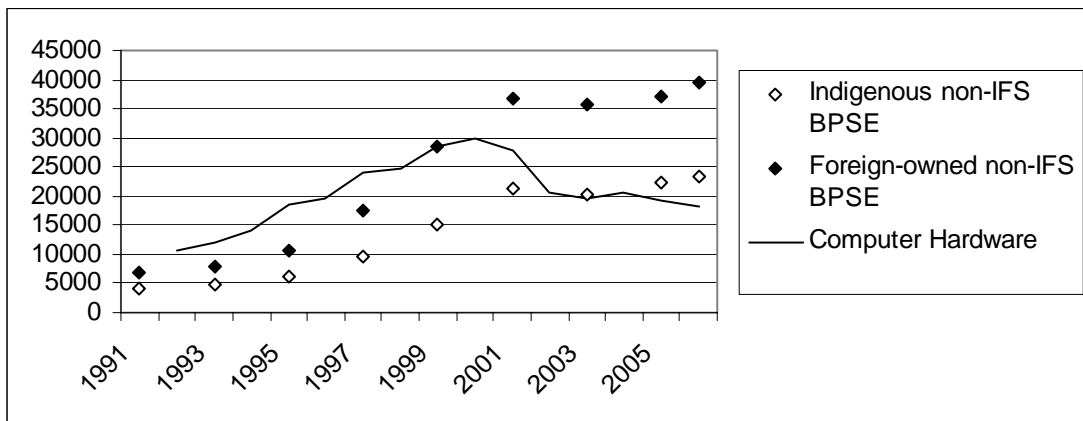
**Table 3: Persons Employed in Computer and Related Services and in All Services**

	Computer and Related Activities	All Services
1999	18,612	515,500
2000	18,779	553,700
2001	22,260	608,500
2002	22,211	668,876
2003	24,030	713,117
2004	28,426	736,969
2005	no data	740,419
Absolute increase 1999-2004	9,814	221,469
Percentage increase 1999-2004	+53%	+43%

Source: Eurostat and CSO *Annual Services Inquiry*.

Figure 5 charts the growth in employment in non-IFS BPSE activities against the decline in computer hardware employment (NACE 30 and 3210).<sup>5</sup> As the figure illustrates, the indigenous BPSE segment now employs around the same number of people as the entire computer hardware sector, while the foreign-owned BPSE segment employs substantially more. Foreign-owned BPSE activities attained about the same level of employment as the entire hardware sector in 2000, gained almost the same number of jobs as the hardware sector shed over the next few years, and has continued its upward expansion since 2003. The indigenous BPSE segment has also grown rapidly over this period, and its current employment level is now at least equal to that in computer hardware.

**Figure 5: Employment in Computer Hardware and Non-IFS Business Process Services Export Activities**



Source: Forfás *Annual Employment Survey* and CSO *Census of Industrial Production*.

The strong growth in computer and related services and in BPSE activities raises the possibility that displaced hardware-sector workers found employment in these related services sectors (as well, of course, as in services

<sup>5</sup> For confidentiality reasons, the most recent employment numbers available for NACE 3210 refer to 2003. We hold employment at this level, comprising 6,542 jobs, for the remaining years shown. We count all agency-supported international services as BPSE, from which we then exclude the international financial services component.



more generally). We will hence look at a number of case studies to try to track their subsequent employment paths.

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### 3. The Rise and Decline of Computer Hardware Production in Ireland: Firm-Level Case Studies

Having begun with an overview of aggregate trends in the sectors under discussion, we now present a brief firm-level history of the computer hardware sector in Ireland.<sup>6</sup>

#### COMPUTER ASSEMBLY

In 1971 Digital Equipment Corporation, one of the pioneers in the minicomputer industry, set up a large-scale minicomputer manufacturing plant in Ireland. This was followed by five other minicomputer companies in the latter half of the 1970s, while Amdahl began to assemble mainframes. Most of these firms closed their Irish plants in the 1980s and were replaced by PC manufacturers, beginning with Apple in 1980. Zenith and Wang followed in the mid-1980s, with both closing their Irish facilities in the early 1990s. Digital, which had started assembling workstations and PCs in Ireland, closed its Irish assembly plants in 1993. These losses, however, were more than offset by the arrival of three new PC assemblers, Dell, Gateway and AST, while an indigenous subcontractor, Horman Electronics, began full system assembly for Apple.

A major breakthrough came in 1989 with the decision of Intel to invest in a sophisticated microprocessor wafer manufacturing plant as well as a PC and motherboard assembly plant. A large number of other companies followed in the early 1990s. By 1999, according to IDA calculations, 33 per cent of PCs sold in Europe were assembled in Ireland, while most operations also included other functions such as sales and technical support call centres, European logistics centres and, in some cases, regional headquarters.

Between 1998 and 2002, the Irish microcomputer assembly sector experienced serious job-losses and plant closures. Intel ceased system assembly in Ireland and consolidated assembly activities in Malaysia, Puerto Rico and, to a lesser extent, the US. Apple shed 450 jobs when the production of i-Mac systems was out-sourced, first to LG Electronics in Wales, subsequently to LG in the Far East, and finally to Foxconn in the Czech Republic. Horman Electronics lost its system assembly contract with Apple. AST and Gateway both closed their European operations. Thus, of the five microcomputer companies existing in 1998, by 2002 only Dell and Apple continued to assemble microcomputers, while Apple's system assembly operations had been seriously downsized.

#### COMPONENTS

The computer component and peripheral sector in Ireland experienced similar churning. In the second half of the 1970s a range of products such as memory, printers, components for disc drives, cables/interconnect material and floppy drives were produced in Ireland, while Digital had opened a plant to produce network components for in-house use. The economic crisis of the early 1980s saw a number of components manufacturers close their Irish plants, while few new investments emerged to replace them. Western Digital opened an automated controller circuit board manufacturing facility and the

<sup>6</sup> This section draws on Van Egeraat and Jacobson (2004, 2005 and 2006).

Keyboard Company set up a facility to supply Apple, though this plant was closed in 1985 shortly after Apple took it over.

During the second half of the 1980s, a number of foreign companies began to assemble keyboards, mice and cables for the expanding local and European markets. BG Turnkey, an indigenous company, carried out simple sub-assembly activities for Apple in Cork and Apple started automated motherboard assembly for in-house use.

More substantial progress was made in the early 1990s. Existing and newly established indigenous companies captured an increasing share of the market for enclosures, cables, printed matter, packaging and supply-chain management services. One of the most significant developments was Intel's decision to invest in a high-tech microprocessor wafer fabrication plant. The accumulated base of component suppliers and system assemblers fed the perception of the creation of an integrated PC cluster, and by 1995 computer assemblers were thought to source 27 per cent of their material inputs in Ireland, up from 6 per cent in the mid-1980s.

In 1996 the IDA started to actively discourage large companies from locating certain manufacturing operations in Ireland, due to increasing competition from low-wage economies. These included peripherals and media, which depended on a lower cost base. New sub-sectors that began to be targeted included software development, contract manufacturing and computer networking/data-communication.

Ireland continued to attract a number of high-tech high-output manufacturing and service projects, notably successive Intel wafer fabrication plants. Furthermore, a substantial number of foreign contract electronics manufacturers (CEMs) continued to invest in enclosure manufacturing and subassembly plants. In most cases this involved the take-over of existing indigenous companies and plants. Between 1995 and 1998 however, a large number of low- and medium-tech component manufacturers closed their Irish plants and shifted production abroad, primarily to the Far East.

At one stage roughly 90 per cent of computer mice sold in Europe were manufactured in Ireland but this ended when Logitech closed its Irish operations. Keyboard manufacturers Keytronics, Alps and Mitsumi shifted keyboard manufacturing from Ireland to the Far East and continued in Ireland as distribution operations only. Seagate closed its hard disk drive assembly facility to consolidate production in the Far East. Disk drive component supplier Applied Magnetics closed. Both Intel and Apple shifted their labour-intensive motherboard assembly activities – also to the Far East – while Intel ceased its cartridge assembly activities to consolidate in the Philippines and Puerto Rico, refitting its Irish plant for wafer production. Six enclosure manufacturing and subassembly plants closed over the period 1999-2003 while other plants downsized.

#### **LOCAL LINKAGES BETWEEN ASSEMBLY AND COMPONENTS**

The Forfás *Irish Economy Expenditure* data suggest that local sourcing of components by microcomputer assembly firms increased rapidly from 6 per cent of material inputs in the mid-1980s to 27 per cent in the mid-1990s and 28 per cent in 1999. These figures, however, include expenditures on items purchased from local supply chain managers but manufactured in other

regions, as well as expenditures on complete systems manufactured by contract manufacturers with local operations. Such items should not be considered as vertical production linkages, however.<sup>7</sup>

More careful analysis by Van Egeraat and Jacobson (2005) which excludes items bought from local supply chain managers suggests that, on average, only 10 per cent of the parts and components sourced by assemblers in Ireland were manufactured in the country. The only items significantly sourced in the region were enclosures, motherboards-backpanels, network cards, non-English language keyboards, digital/printed media, cables/interconnect and packaging materials, and accessory kits.

Furthermore, the actual production activities in many plants added limited value to the product. For example, apart from digital printing activity, eleven kitting plants merely packaged media and other language-specific parts. Similarly, five keyboard localisation plants merely laser printed (non-English-language) keyboards that had been manufactured overseas. Similarly, the production activities of turnkey suppliers involved in rework activities added little value. Hence, the relocation of the computer hardware sector should not have as large a secondary effect on the economy as might otherwise be thought.

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#### 4. Inter- and Intra-Firm Adjustments Within the ICT Sector in Ireland

As seen earlier, the Irish computer hardware sector lost about 10,000 jobs, or one-third of its employment, between 2000 and 2004, with about two-thirds of the job losses occurring in NACE 30 (manufacturing of office machinery and computers). There was at the same time, however, a substantial restructuring into related services segments (and into services more generally), in some cases within the same firm.

The following sections detail the experiences of several computer assembly companies in transforming their Irish operations and trace, to the extent possible, what became of displaced workers.<sup>8</sup>

##### **APPLE**

Apple established a manufacturing operation in Cork in 1984. In 1998, however, by which time it employed a total of 1,900 workers in Ireland, it closed its Claris subsidiary in Dublin with the loss of 125 jobs.<sup>9</sup> In July of that year, in the face of recent accumulated losses of \$1 billion, the company announced it was shifting its printed circuit board facility to the Far East, leading to the shedding of 150 full-time jobs and as many as 400 temporary posts from the company's Irish operations. At the same time, however, it was announced that the final assembly and test processing of the new low-cost

<sup>7</sup> The fact that a company's Global HQ subcontracts production to a company that happens to have a plant in Ireland may have little to do with the fact that the company has a plant in Ireland. In this case it is not a local linkage.

<sup>8</sup> A number of the computer assembly closures pre-2000 do not show up in the aggregate sectoral data mainly because Dell continued to expand until 2001. With regard to components, again some of the pre-2000 redundancies do not show up in the industry-level data because quite a number of companies (and particularly the high-tech element) were expanding up to 2001.

<sup>9</sup> The material on Apple is based on reports carried in *The Irish Times* (July 2 and Sept 18, 1998; Jan 30 and Feb 2, 3 and 5, 1999; and Jan 13, Feb 16 and July 5, 2001).

and versatile iMac, on which the company pinned its hopes of recovery, would move to Ireland.<sup>10</sup> The Irish operations were also focused on the production of the company's latest powerful G3 processor products for Europe, the Middle East and Africa (EMEA). Ironically, however, the subsequent success of the iMac led the company to outsource production to the Korean electronics company Lucky Goldstar, which shifted production to its facilities in Singapore, Mexico and Wales, leading to the announcement of a further 500 job losses in the Irish plant in 1999 (with most of the actual redundancies occurring in 2000-2001). Production of the G3 desktop computer, designed for the business market and with a much higher profit margin than the iMac, was to remain in Ireland and the company's European HQ was also to remain here.

By 2001, less than 400 of Apple's Irish workforce of 1,200 were involved in manufacturing. European customer support services and finance functions had been recently transferred to Ireland, which also functioned as a logistics centre for the company, and its Cork location was transformed from a manufacturing base to a services campus. Local management had responsibility for sourcing and logistics and acted as landlord for R&D groups engaged in localisation and software, with the latter managed from the US.

Apple was the only unionised plant in the sector and workers were organised by the trade union SIPTU. SIPTU reports that the market was quite buoyant at the time of the job losses and that most workers found new employment relatively easily.<sup>11</sup> A substantial number of people are reported to have gone to Flextronics and to EMC (which is engaged in storage hardware manufacturing). Both were recruiting at the time and were looking for workers with similar skills, while a number of women were said to have used their redundancy payments as an opportunity to stay at home and spend time with their children (Interview with local SIPTU representative, June 2005).

### **GATEWAY**

Gateway established a manufacturing and support hub for the EMEA region in Dublin in 1993. The operation was closed in summer 2001 when the company decided to refocus on the US market. Nine hundred staff were employed at its European HQ in Ireland at the time, 400 of whom were in lower skill manufacturing jobs and a further 250 in technical support. This was the single biggest redundancy announcement since US technology firm Seagate closed its operations in Clonmel, Co Tipperary, in 1997.<sup>12</sup>

Though the plant, like most foreign-owned high-tech operations in Ireland, was not unionised, the redundant Gateway employees, with the assistance of the Irish Congress of Trade Unions and SIPTU, received a redundancy package considered to be one of the most generous on offer within the industry. Gateway also agreed to repay Irish government grants of IR£19 million, though the figure was to be reduced if the company

<sup>10</sup> Singapore had also been under consideration.

<sup>11</sup> One union contact recalls an incident during the writing of redundancy cheques when one person asked to be allowed to jump the queue "...because otherwise he would be late for work".

<sup>12</sup> The information on Gateway comes inter alia from *The Irish Times* articles of July 21, August 1, 9 and 17, Oct 30, Nov 22 and Dec 21, 2001.

outsourced some of its displaced workforce to other firms (such as Clientlogic, discussed below) which were also located in Ireland.

Telecom suppliers were expected to be particularly adversely affected by the closure of the plant, and hence were hopeful that Gateway would outsource its technical support services to an Irish company. At least 15 companies – based in the Republic, Britain and Europe – contacted Gateway to express interest in providing these services. Ultimately, Gateway signed an outsourcing deal with a Dublin-based Canadian firm, Clientlogic, which saved about 150 technical support jobs.<sup>13</sup> Though demand for Gateway customer support services would decline over time because of its decision to exit the EMEA region, Clientlogic expected to be able to shift these workers to other client accounts such as British Telecom, Boots (Chemists) and Dublin-based electronics group Palm.

As well as receiving 75 per cent of Gateway's redundancy package, those who transferred to Clientlogic were offered exactly the same work conditions as before.<sup>14</sup> Even given this lucrative offer to 115 of Gateway's technical support team of more than 200, only 60 took up the offer, revealing the buoyancy of the sectoral jobs market.

Many of the staff from Continental Europe were reported to have returned home on receipt of redundancy payments. Other foreign-language call centre workers brought their highly transferable skills to other local call centres such as Hertz. Many of the younger Irish staff were reported to have taken time off to travel. An IDA Ireland spokesman noted that it reflected a new psychology among the younger and more skilled elements of the Irish workforce and was quoted to the effect that "...the younger generation, who have gone through college, tend to be more flexible and optimistic than workers in traditional industries".

Unlike in the case of previous large redundancies, no government task force was set up on this occasion. FÁS established an on-site employment office for one month at the time of the closure, with 21 companies from North Dublin attending a jobs fair in Gateway to recruit staff for their operations.<sup>15</sup> About one-quarter of staff who completed outplacement courses were reported to have found jobs before the plant's official closure. A further 250 Gateway staff indicated that they wished to take up FÁS evening classes in a range of skill areas. Many of these – a number of whom were veterans of previous redundancies by Amdahl, Motorola and others – secured employment within months.

These positive developments for those with technical and managerial skills should not mask the fact that production-line operatives, who tend not to have tertiary-level educational qualifications, fared less well according to the

<sup>13</sup> The deal between Gateway and Clientlogic mirrored that agreed by Motorola and Celestica the previous year, when the two firms signed an international alliance. Under this agreement, most of the Motorola staff transferred to the electronics manufacturing firm.

<sup>14</sup> Gateway also agreed to cover the tax liability on the once-off payments for employees transferring to Clientlogic.

<sup>15</sup> Gateway revealed that upon the announcement of closure it had received inquiries from six different Irish-based companies, one of which was electronics manufacturer Flextronics, who were interested in hiring some of its staff.

specialist outplacement agency brought in by Gateway and the client management director at Clientlogic.

## **INTEL**

Intel opened its European HQ in Ireland in 1989. PC and motherboard assembly began shortly thereafter, as did construction of a sophisticated microprocessor wafer manufacturing plant. The assembly operations reached their employment maximum of around 1,500 in 1997. It subsequently shifted its labour-intensive motherboard assembly activities from Ireland to the Far East, as did Apple; it ceased system assembly in Ireland and consolidated assembly activities in Malaysia, Puerto Rico and, to some extent, in the USA, and it consolidated cartridge assembly in its plants in the Philippines and Puerto Rico. It then refitted its Irish plant for much higher-level wafer production.

*The Irish Times*, in June 1999, reported that some 750 Intel employees involved in assembly functions were informed that their jobs would be gradually eliminated as the company upgraded its Irish operations to produce the latest microchips. Each of the assembly staff were offered retraining and redeployment to allow them to transfer to the new production process, for which the company estimated that an additional 1,000 employees would be required. Workers transferring from the assembly facilities had their existing pay grades preserved.

## **DELL**

Similar processes operated in the case of Dell.<sup>16</sup> Manufacturing operations were located in Limerick while a European logistics centre, a 140-strong European Product Group (involved mainly in localisation as well as product and process development) and a sales, technical support and marketing centre were located in Bray, near Dublin.

In 2001, the company announced a voluntary redundancy package for 200 of its 4,000+ employees in Limerick, the first in its 10-year history in the city. The job shedding was largely confined to office staff. The firm's 1,200 employees in Bray and in Cherrywood, in Dublin, were unaffected. Those affected were offered "competitive severance packages", including more than six weeks pay per year of service, extended medical and life cover, career counselling and out-placement assistance. The following year the firm announced the creation of between 100 and 200 full-time jobs at its call centre in Bray. Many of these were to be in highly skilled positions at Dell's new multilingual centre, offering technical support services for the firm's server and storage products.

## **AST (ARI SERVICES EUROPE)**

AST was set up in Irvine California and began to operate in Limerick in September 1994. It was taken over by Samsung (Korea) in September 1997, by which time it had 4,000 employees globally, with locations in Limerick, Texas, California and China. At its high-water mark in Ireland it

<sup>16</sup> The material on job losses in Dell comes from *The Irish Times*, May 24, 2001, and August 17, 2002.

had 750 employees. By December 1997 this had fallen to 450, all of whom had permanent contracts.

That month the firm announced that 150 Irish jobs were to be shed as part of a global restructuring plan. These 150 were expected to find employment at the nearby Dell and Cabletron facilities. The Irish facility was eventually sold to Dell and a substantial component of the workforce simply transferred to Dell.

In 1998 the company announced that it was withdrawing from the EU market for desktop computers and server machines (underlining the growing dominance of the PC market by the “big four” – Compaq, Dell, IBM and HP) to focus on portable notebooks. The smaller Limerick facility now operates as ARI Services, a purely services company owned by Samsung.

### **DIGITAL ELECTRONICS CORPORATION (DEC)**

An indication of the possible long-term effects of jobs losses may be gleaned from analysis of the demise of DEC’s manufacturing operations in Galway City in the early 1990s.<sup>17</sup> DEC began manufacturing in Ireland in 1971, producing computers for the local market and eventually moving into software, systems and support engineering.

The closure of the manufacturing plant in 1993, which resulted in 760 redundancies, was seen as devastating for the West of Ireland as the company’s net worth to the region was estimated at some IR£100 million per year.

The closure, however, created new opportunities in the region for the pool of skills that the company had employed. Digital itself established in-house programmes for job search, career change, new business start-ups and relocation, and this was supplemented by an Inter-Agency Task Force established by the Department of Enterprise and Employment. The most significant outcome was the establishment of Galway Technology Centre, the provision of additional training support and advisory services and funding for business start-ups, including via the conversion of tax on redundancy pay into seed capital grants.

Business support, training and “incubator” facilities together with informal networks among key ex-Digital staff all played a part in an ongoing transformation of the local economy. Several high-profile successes such as Toucan Technology encouraged other start-ups and helped attract major new investors such as Siebel Systems, while persuading existing ones such as Nortel and Compaq (which absorbed the software and computer engineering areas of Digital) to expand their operations. It also contributed to the emergence in Galway of Europe’s leading medical instruments cluster.

The year after the Galway closure, Digital opened a PC support centre in Dublin and later opened a multi-million euro call centre at a new site. At the time of the closure of the Galway plant the company employed 1,700 in

<sup>17</sup> The material on DEC draws on Green *et al.* (2001), Giblin, Ryan and Moroney (2003) and Van Egeraat and Jacobson (2004).

Ireland. By 1998 employment numbers were back up to 1,400 (comprising its HQ in Dublin and what had been its European Software Centre in Galway).

## **IBM**

IBM's restructuring in Ireland differs from that of the other computer assembly companies, largely due to its later establishment in Ireland as a hardware manufacturer. Its Irish presence began with a small sales operation in 1956. In the early 1980s it was one of the first companies to establish an international software facility in the country. After a period of downsizing in the early 1990s, the company acquired Lotus in 1995 as part of its corporate strategy shift from products to services and solutions. Re-named the Dublin Software Lab, this group brought IBM's total workforce in Dublin to 1,000 and added a significant software development component to its portfolio.

The real turnaround came in 1996 when the company started to invest heavily in Ireland as EU developments allowed it to rationalise its European operations. The company first opened a PC customer support centre, catering for 29 countries (including the US). The same year it began to develop its technology campus at Mulhuddart in County Dublin, which included its first Irish manufacturing operation as well as a range of other services. From the outset, manufacturing activities were of a relatively high value-added nature, including the manufacturing and testing of logic chips, production of disc drive platters in a clean room environment and, since 1999, production of customised high-end network servers.

Since then, the Irish operations have continued to restructure, driven by the continued corporate shift towards services, a search for efficiency in global production capacity and changes in local factor-market conditions. In 2000 IBM placed Dublin at the core of its global e-commerce strategy by establishing a supplier portal and data centre to support electronic business activities to corporate customers. The portal accounted for 40 per cent of IBM's global web-based procurement. In 2001, the hard disk drive operation was relocated to Germany but no redundancies followed among the 300 staff involved as new investment occurred in the remaining two manufacturing divisions and in high value added activities such as supply chain management (*The Irish Times*, 2 February 2001). IBM Ireland was unaffected by the corporate decision taken in 2002 to cut 20,000 jobs globally.

Within services the focus is gradually shifting from low to high-value-added activities. Maintenance of laptop computers and call centre support for personal computers have been re-located to lower cost locations, but again all staff were redeployed in higher value-added activities. The technical support call centre was transformed into a "dotcom centre" with staff selling services directly to clients rather than simply offering support. (*The Irish Times*, 16 August 2002). The Dublin Software Lab expanded and in 2004 launched the Dublin Centre for Advanced Studies, one of seven such centres run by IBM worldwide. Most recently the company created 300 new jobs in a range of projects, including three Competency Centres developing software in areas such as biomedical search and service-oriented architecture, an IBM Business Incubation Centre, a European Venture Capital Centre, an Innovation Centre and new supply chain operations. By 2006 IBM Ireland employed over 3,700 staff and its 2004 turnover stood at €2.5 billion.



The aim of the paper has been to study the process of employment adjustment as the computer hardware sector relocated out of Ireland over the early years of the new millennium. Our brief history of the sector revealed that there had been extensive churning both of firms and of activities over the entire period since mini-computer and mainframe assembly began in the 1970s. These early firms were replaced by new PC assembly firms in the mid-1980s and 1990s, so that by the late 1990s Ireland had become one of the major European locations for computer assembly.

Ireland at this stage also accounted for around 6 per cent of global exports of electronic components. This segment had also been characterised by extensive churning. Motherboard assembly and manufacturing of keyboards and computer mice shifted abroad over time while higher value-added manufacturing activities, notably the production of microprocessors, continued to expand. One producer, Intel, now accounts for a large share of Irish components employment, and is estimated to have invested some €6 billion in Ireland since it first set up operations in the country in 1989.

Over recent years, both segments have experienced serious job losses and a number of plant closures. The case studies illustrate the various paths followed by displaced employees. Plant closures have occasionally led to high-tech spin offs, as in the case of Digital and more recently in Motorola.<sup>18</sup> Some displaced workers remained employed in their original companies but moved to other (higher value-added) manufacturing jobs following retraining, as seen in the case of Intel. Others, as in the cases of AST and Gateway, were able to move rapidly into expanding companies in the local area, serving as an indicator of the value of the skills accumulated in the sector. Other displaced workers chose to leave the labour force voluntarily.

A number of hardware companies, such as Apple, remained in Ireland and shifted their Irish operations, and some of their displaced workers, into services activities. As Grimes (2006) notes, "...the general trend is for an on-going shift away from hardware manufacturing towards a greater involvement in software, R&D and a range of other support services. The growth of internationally traded services activities in these technology corporations reflects an evolution towards a greater involvement in servicing other affiliates and the various 'geographies' of their client base, as they become increasingly internationalised."

In this regard, we pointed to the substantial employment growth in computer services and Business Process Services Export activities (BPSE) as the hardware sector declined. As many jobs were created in computer services as were lost in hardware over the early years of the new millennium, while non-IFS BPSE, and of course total services, expanded much more dramatically.<sup>19</sup> The indigenous (non-IFS-related) BPSE segment now employs around the same number of people as the entire computer hardware sector, while the foreign-owned BPSE segment employs substantially more.

<sup>18</sup> "Motorola Alumni Try Out as Entrepreneurs", Sunday Tribune, May 15, 2007. Spin-off activities will not necessarily be reflected in an increase in the number of companies in the sector because they do not necessarily occur in the same sector.

<sup>19</sup> BPSE includes software and computer services and a variety of other services such as call centres. Some 35 per cent of Irish call centres are in the technology sector and Ireland is known to attract more high-value, less price-sensitive call centre activity than other offshore locations (Barry and van Welsun, 2005).

Clearly, not all employees would have found it equally easy to find new jobs. The international literature identifies older workers with low educational attainment as having the poorest re-employment prospects and this is confirmed in the Irish data. Denny *et al.* (2000), for example, show that the probability of being in employment rises with the level of educational attainment while O'Connell (1999) shows that the share of long-term unemployment in total unemployment increases with age.

The sector under discussion in the present paper is atypical in that it is characterised by higher educational attainment and a lower age profile than the manufacturing average, both of which suggest that workers displaced from this sector would have had better than average chances of finding new employment.<sup>20</sup> We also saw that the pools of skills that had been employed and expanded – even by hardware companies that later downsized and retreated – created new opportunities for the regions in which they had located.

It suggests that though the ability of displaced workers to move to new employment relatively easily was undoubtedly assisted by the overall buoyancy of the economy over the period under discussion, the adjustment problems associated with churning and displacement in sectors of this type may be substantially less than in traditional lower value-added sectors.

Might one expect this same relative ease of adjustment to occur if other low-age-profile sectors with equivalent or higher educational attainment profiles – such as Pharmaceuticals and Medical and Precision Instruments – were to shift eastwards? Perhaps not, since the skills structure in these sectors might be less closely related to cognate services activities than in the case of computer hardware. However, jobs in these other sectors appear to be less likely to be lost. The analysis of Forfás employment data in the Appendix shows that job persistence is greatest in the two sectors Chemicals and Chemical Products and Medical and Precision Instruments. The thrust of the various strands of evidence upon which we have drawn in the paper is to suggest that the flexibility of the labour market will be enhanced by the increasing educational attainment of the workforce and a concurrent expansion in the share of modern higher-technology sectors.

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<sup>20</sup> The most recent *Census of Population* (Volume 7, Table 16) shows that the Metals, Machinery and Engineering sector – the broad sector that includes computer hardware – has a younger age profile than overall manufacturing, while Barry (2007) shows that educational attainment in this sector is higher than the average for manufacturing. The average wage is also frequently used as a proxy for human capital. The *Census of Industrial Production* (2004, Table 13) reveals that the average wage in NACE 30 is 13 per cent above the manufacturing average. *CIP* (2000, Table 14) provides the most recent disaggregated data for NACE 3210. At that time, wages in this sector were above those for NACE 30 and were 8 per cent above the manufacturing average.

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# APPENDIX: JOB PERSISTENCE ACROSS SECTORS

Forfás employment survey data allow one to track changes in job numbers in individual plants over time, and to determine how long these changes in employment numbers persist. This is frequently treated as a proxy for job life, though it does not capture intra-firm job turnover for example.

Results for job-creation persistence by sector three years after initial job creation are given in Table A1. Differences in sectoral job-persistence measures may simply reflect differences in plant size, plant age and nationality

**Table A1: Percentage of New Jobs Remaining after 3 Years, by Sector\***

	<b>NACE</b>	<b>3 Years</b>	<b>Unadjusted Rank</b>
Food Products	15	54	13
Drink and Tobacco	16	69	5
Textiles	17	52	16
Clothing	18	44	20
Leather and Footwear	19	33	22
Wood Products	20	50	19
Pulp paper and paper products	21	58	9
Publishing and Printing	22	57	10
Manufacturing of coke, refining	23	54	14
Chemicals and Chemical	24	74	1
Rubber and Plastic Products	25	56	12
Other Non-Metallic Mineral	26	53	15
Basic Metal Products	27	40	21
Fabricated and Structural Metal	28	51	18
Machinery and Equipment n.e.c.	29	57	11
Office Machinery and Computers	30	70	3
Electrical Machinery and	31	61	7
Electronic Equipment	32	70	4
Medical and Precision	33	73	2
Motor Vehicles and Equipment	34	59	8
Other Transport Equipment	35	63	6
Other Manufacturing n.e.c.	36	51	17
Recycling	37	27	23

\*This is taken from background work prepared by Frank Barry and Eric Strobl for Walsh *et al.* (2003).

of ownership. Jobs created in younger plants are substantially more persistent than those in older plants while jobs created in foreign plants are more durable than indigenous ones. From a policy perspective, however, the fact that sectors differ across these characteristics is important and we do not therefore control for them (in the sense of reporting on what each sector's persistence rate would be, were age, size and nationality in the sector simply to reflect the manufacturing average).